# Sustaining the Momentum

I was asked to explain (a) why I have been an active supporter of the mathematical community, (b) what I have done, and (c) what needs to be done to sustain the mathematical sciences initiative at the National Science Foundation (NSF).

The answer to why is fairly simple. While serving as the director of the National Security Agency, I realized that world-class mathematicians devoted to cryptology and cryptanalysis were critical for success. I was even more fascinated when I was made aware that continuing advances in mathematics are no less critical to breakthroughs in *all* of science and technology.

Most nonmathematicians believe that almost everything in mathematics has already been invented, while they hear regularly of new advances in physics, biology, chemistry, and other sciences. In fact, this belief is wrong. The proof of Fermat's Last Theorem, of course, was a public event, but also a rare one, with little apparent practical relevance in the minds of nonmathematicians. An equivalent event seems unlikely anytime soon. Yet mathematicians do make frequent breakthroughs, and the consequences for all other branches of science can be enormous, not to mention the technological and economic gains that can follow.

That was a dramatic revelation for me, and I soon learned that I was not alone. Even leading scientists in other fields sometimes are not aware that they are limited by extant mathematics and that new mathematics can be developed, leading to major advances in their own work. As a result, mathematics was suffering from declining financial support. Yet a strong mathematics community is critical to both the economic and the military health of the nation. This is why I became involved in support for mathematics as a public policy issue.

In 1995 I was asked to chair a mathematics assessment panel for the NSF. Astonished, I said, "But I am not a mathematician. Are you sure you want me?" Don Lewis, then serving as the head of the Division of Mathematical Sciences at NSF, assured me that this was what qualified me for the job. The panel required a nonmathematician in order to remove any sign of parochial self-interest in its findings. If a poor knowledge of math was the standard, then I was superqualified! For the next year and a half, I had the privilege of working with the extraordinary group of mathematicians on the panel, who lucidly explained the many problems in the field.

The panel discussions made me aware that U.S. mathematics, although dominant in the world at the time, was heading for serious trouble unless it received greater resources. Armed with the strong arguments that the panelists brought to their report, we all could make the case for more funding for mathematics.

A lot of positive change has occurred within the pure mathematics community, and that has helped in making the budget case within the NSF. Philippe Tondeur, who succeeded Don Lewis, kept up the momentum of Lewis's initiatives. That explains the subsequent success in improving support for mathematics. An old maxim of bureaucratic politics holds that policy outcomes are determined, not by the intellectual merits of the arguments for the alternatives, but by the bureaucratic power behind them. Unlike theorems in mathematics, this maxim has exceptions. When NSF director Rita Colwell had to make a decision about funding priorities, she made it on the merits—a true act of putting public interest over private interest. Tondeur's abundant supply of good arguments found an open mind at the top of the NSF. In turn, he and the director found some remarkable support in the White House and in the Office of Management and Budget, where mathematics is now seen as a high-payoff investment.

This sums up the little that I have done, which is mainly to observe, urge now and then, and applaud. What now needs to be done?

Winning the budget battle in the executive branch is only the beginning. Ultimately, Congress controls the purse strings. The mathematics community at large, therefore, needs to keep making its case to key legislators.

There is also a larger public information challenge. We "lay people" don't hear about the exciting advances regularly occurring in mathematics the way we do in other sciences. Once we know about the feats of mathematics, we become supporters. A few leaders in mathematics are addressing this problem by cultivating public awareness programs. The USA Mathematical Olympiad makes a great contribution. Such work is not undignified advertising or PR. It is analogous to the outreach programs offered by conductors of major symphony orchestras to build future audiences. It is like music theory taught in secondary schools in parts of Europe, where students are introduced to fugue and sonata forms.

The mathematics community has an incredible case to make and remarkable stories to tell. Creating a mathematics culture in the larger society should be the community's strategic goal. Not just mathematics, but all the sciences and society as a whole will gain from it.

*—General William E. Odom (U.S. Army, Ret.)*
*Senior Fellow, Hudson Institute*

# Letters to the Editor

## Menahem Max Schiffer

The sad passing on November 11, 1997, at the age of 86 of Menahem Max Schiffer, one of the most distinguished mathematicians and scholars of his time, seems for some years to have escaped the notice of the mathematical community. A belated obituary appears in the February 13, 2002, issue of the *Stanford Report*, a publication devoted to news and information for the Stanford University community. The following comments are excerpted from that article.

Schiffer was born in Berlin in 1911, attended a secondary school that stressed science and mathematics, and entered the Friedrich-Wilhelms Universität, Bonn, in 1930, with a major in physics, which he studied under von Laue, Nernst, and Schrödinger. He also studied mathematics under Bieberbach, Schmidt, and Schur. Schiffer changed his major to mathematics and worked for a time under the guidance of Schur. His initial paper, "Finiteness theorems of invariant theory", was published in 1934 in the *Mathematische Zeitschrift*.

With the Nazis in power and with Schur having been forcibly "retired" because he was not of Aryan descent, Schiffer emigrated to Palestine. He received his M.A. degree at the Hebrew University of Jerusalem, based on the material of his 1934 publication. His Ph.D. dissertation at the Hebrew University in 1938, "Conformal representation and univalent functions", initiated his active interest in complex analysis. It is for his work in this field that Schiffer achieved his greatest acclaim. His thesis introduced what was later to be known universally as the "Schiffer variation", actually one of two important variational methods that he initiated and developed. Schiffer's work opened up the possibility of applying variational methods in a systematic way to geometric problems in complex analysis. His results provided new, powerful, and flexible tools for studying classical problems, and they moved the subject in exciting new directions. He had great success in applying his methods to many fundamental questions, and anyone working in the field has to be familiar with the techniques he crafted.

Never losing his interest in mathematical physics, Schiffer also made important contributions to eigenvalue problems, to partial differential equations, and to the variational theory of "domain functionals" that arise in many classical boundary value problems. And he coauthored a book on general relativity. Schiffer was a prolific author over his entire career, with 135 publications from the 1930s to the 1990s, including four books and around forty different coauthors. He was also an outstanding mathematical stylist, always writing, by his own testimony, with the reader in mind. He sought always to convey the joy of discovery and the deep satisfaction in the unity of the subject. Among his publications are several long expository papers which still remain the best and most accessible treatments of the subjects.

The spirit and polish in Schiffer's papers were also evident in his teaching. His lectures at Stanford and around the world ranged greatly in subject matter and were widely appreciated. He was invited to address the International Congress of Mathematicians in 1950 and again in 1958. At Stanford he often taught graduate courses in applied mathematics and mathematical physics. Students from all departments flocked to them, as did many faculty. Each lecture was a perfect set piece—no pauses, no slips, and no notes. In 1976 he was chosen as one of the first recipients of the Dean's Award for Teaching in the School of Humanities and Sciences.

Schiffer became professor of mathematics at Stanford University on September 1, 1952, following earlier positions at the Hebrew University, Harvard, and Princeton. He served as executive head from 1954–1959. In 1967 he was appointed to the Robert Grimmett Professorship of Mathematics, becoming the first member of the department to be awarded an endowed chair; he held that position until his retirement in 1977. In 1968 he was elected to the American Academy of Arts and Sciences and in 1970 to the National Academy of Sciences.

Menahem Schiffer's passing marked the end of an era, in which celebrated names from the "old world", including Bergman, Loewner, Pólya, Schiffer, and Szegő, created at Stanford University one of the great world centers for classical analysis.

*—Robert Finn*
*—Brad Osgood*
*—Robert Osserman*
*Stanford University*

(Received May 3, 2002)

? WHAT IS...

### Not to Miss

What is a gerbe? How about a brane, a grope, a shtuka? Today's mathematics is full of intriguing objects with weird and wonderful names. This issue of the *Notices* inaugurates a new feature called the "WHAT IS...?" column.

The *American Mathematical Monthly* has published, starting in 1942 under the editorship of Lester R. Ford Jr., an occasional series of articles with the title "What is...?". The *Notices* "WHAT IS...?" column is a bit different, in that each column treats a single mathematical object, rather than a theory. The column is pitched to graduate students, so the technical level is low and the accessibilty is high.

"WHAT IS an amoeba?" by Oleg Viro appears on page 916 in this issue.

Comments on the "WHAT IS...?" column are welcome and should be sent to `notices-whatis.org`.

*—Allyn Jackson*